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US ISSN 0085-0683

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Marine Research Laboratory
Florida Department of Natural Resources
St. Petersburg, Florida

VOLUME III SEPTEMBER 1973 PART III

BRACHIOPODS (RECENT)

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By

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ABSTRACT

Brachiopods collected during Project Hourglass consist of an inarticulate, *Glottidia pyramidata* (Stimpson), and an aberrant articulate, *Platidia,* new species. The well known *Glottidia* is discussed only briefly. Muscle arrangement in the *Platidia* is like that of *Megerlia* in which adjustor muscles are well developed but diductors are reduced. To open its valves, the *Platidia* must lift itself on its pedicle. The muscle arrangement that facilitates this and the opening of the valves is explained.

INTRODUCTION

In 1971, I was permitted to study brachiopods collected in 1966 and 1967 in the Gulf of Mexico from shelf waters between Tampa Bay and Sanibel Island, Florida. The specimens proved to belong to two species in two subclasses: Inarticulata Huxley 1869, and Articulata Huxley 1869. The inarticulate is the fairly common *Glottidia pyramidata* (Stimpson) that occurs from Chesapeake Bay to Miami on the Atlantic coast and from Marco to Panama City on the Gulf coast. The articulate

Contribution No. 221, Florida Department of Natural Resources Marine Research Laboratory.

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belongs to the aberrant genus *Platidia.* The species is new and displays a number of interesting features.

ACKNOWLEDGMENTS

I am indebted to Mr. Robert M. Ingle, former Chief of the Bureau of Marine Science and Technology, Florida Department of Natural Resources, for permitting me to study the specimens. I am grateful to Mr. William G. Lyons for transmitting specimens and furnishing necessary data. I acknowledge with thanks the help of Mr. Lawrence B. Isham, Visual Information Specialist, Department of Paleobiology, Smithsonian Institution, who drew the musculature of the tiny *Platidia.* I am grateful to Drs. R.E. Grant and J.T. Dutro, Jr. for reading the manuscript and offering many helpful suggestions.

METHODS AND MATERIALS

Brachiopods were collected by the Marine Research Laboratory, Florida Department of Natural Resources during Project Hourglass, a 28-month systematic sampling program on the west Florida shelf (Joyce and Williams, 1969). Ten fisheries stations (A-E and I-M), five along each of two transects off Tampa Bay and Sanibel Island (Figure 1; Table 1) were sampled monthly for benthic organisms from August 1965 through November 1967. All stations were sampled at night (regular cruises); Stations B, C, and D were revisited each month during daylight hours (post-cruises). Supplementary cruises were made in July 1966 and January 1967.

During regular and post-cruises, 15 min (bottom time) box dredge and 30 min trynet tows were made. On supplementary cruises, a 45 ft otter trawl was towed for 30 min. Detailed gear specifications and all collection data were presented by Joyce and Williams (1969).

All specimens are deposited in the National Museum of Natural History, Smithsonian Institution (USNM), or in the Invertebrate Reference Collection, Marine Research Laboratory, Florida Department of Natural Resources (FSBC I).

TABLE 1. LOCATION OF HOURGLASS FISHERIES STATIONS.

Station	Location* Lat.	Long.	Established Depth Meters	Approximate Nautical Miles Offshore*
A	27° 35'N	82° 50'W	6	04-due W of Egmont Key
B	27° 37'N	83° 07'W	18	19-due W of Egmont Key
C	27° 37'N	83° 28'W	37	38-due W of Egmont Key
D	27° 37'N	83° 58'W	55	65-due W of Egmont Key
E	27° 37'N	84° 13'W	73	78-due W of Egmont Key
I	26° 24'N	82° 06'W	6	04-due W of Sanibel Island Light
J	26° 24'N	82° 28'W	18	24-due W of Sanibel Island Light
K	26° 24'N	82° 58'W	37	51-due W of Sanibel Island Light
L	26° 24'N	83° 22'W	55	73-due W of Sanibel Island Light
M	26° 24'N	83° 43'W	73	92-due W of Sanibel Island Light

*U. S. Coast and Geodetic Chart 1003 dated June 1966.

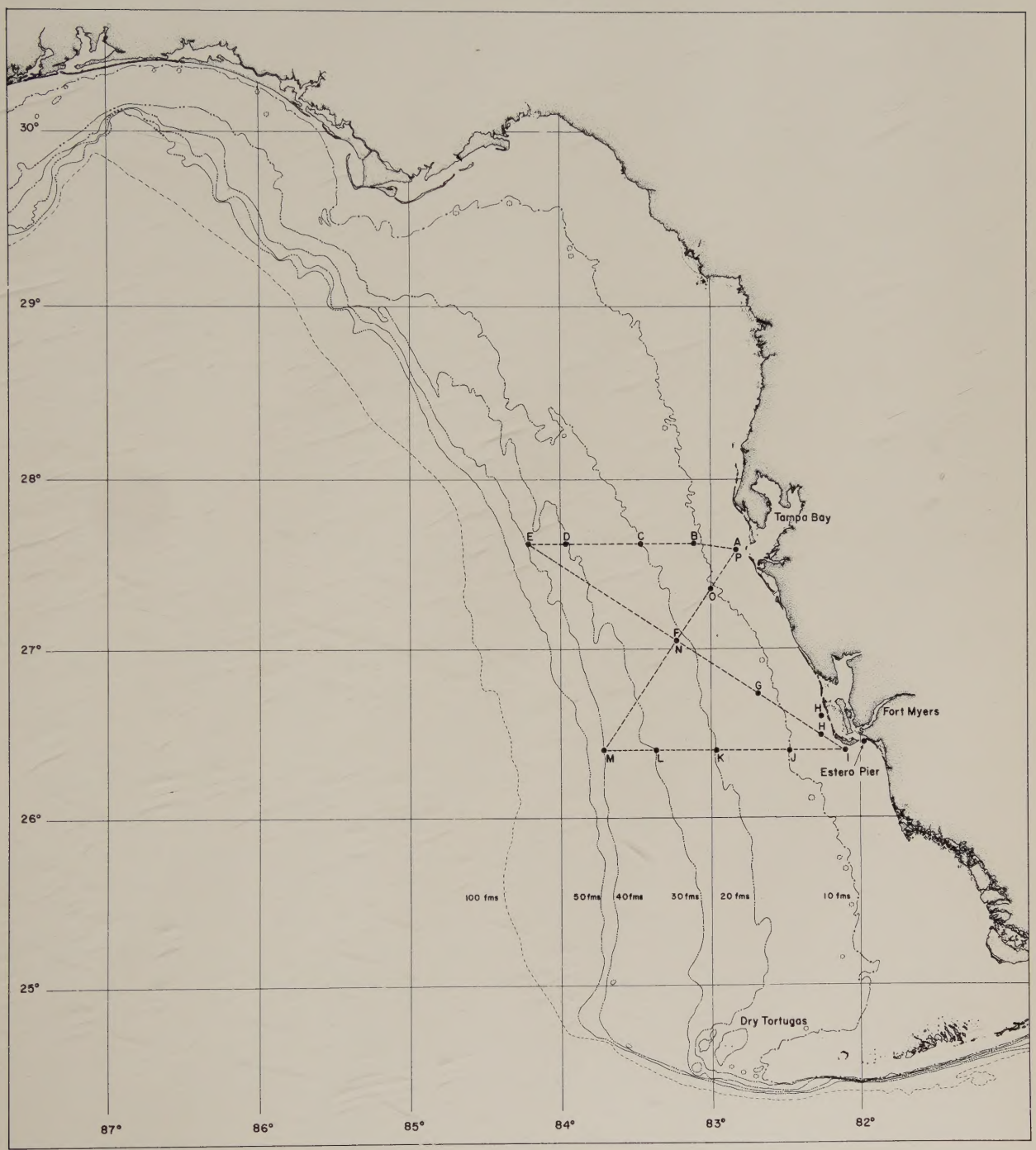

Figure 1. Hourglass cruise pattern and station locations.

SYSTEMATICS

SUBCLASS INARTICULATA HUXLEY, 1869

ORDER LINGULIDA WAAGEN, 1885

Superfamily Lingulacea Menke, 1828

Family Lingulidae Menke, 1829

Genus *Glottidia* Dall, 1870

Glottidia pyramidata (Stimpson, 1860)

Plate I, Figures 26-30

Lingula pyramidata Stimpson, 1860, p. 444; Brooks, 1879, p. 35 + 112, pls. 1-6.

Glottidia pyramidata: Dall, 1870, p. 158; 1873, p. 204; Beyer, 1886, p. 227-265, pls. 14-17; Davidson, 1888, p. 223, pl. 28, figs. 10, 11; Morse, 1902, p. 313-386, pls. 39-54; Dall, 1920, p. 268; Hertlein and Grant, 1944, p. 19, pl. 16, figs. 9, 20 [extensive bibliography]; Paine, 1963, p. 187-212.

Material examined: HOURGLASS STATION A: 5; 2 June 1967; dredge; USNM 550753.–HOURGLASS STATION B: 1; 18 October 1966; dredge; FSBC I 9126.–HOURGLASS STATION D: 1; 21 May 1967; dredge; FSBC I 9127.–HOURGLASS STATION E: 2; 2 August 1966; dredge; FSBC I 9128.–HOURGLASS STATION I: 1; 9 March 1966; from stomach of *Symphurus plagiusa* Linné; FSBC I 9129.–1; 9 March 1966; from stomach of *Symphurus plagiusa* Linné; FSBC I 9130.–2; 12 October 1966; dredge; FSBC I 9131.–2; 12 November 1966; dredge; FSBC I 9132.–2; 6 December 1966; dredge; USNM 550752.–3; 15 February 1967; dredge; USNM 550751.–1; 5 July 1967; dredge; FSBC I 9133.–HOURGLASS STATION L: 2; 5 September 1966; dredge; FSBC I 9134.–HOURGLASS STATION M: 1; 5 September 1966; dredge; FSBC I 9135.–1; 13 October 1966; dredge; FSBC I 9136.–1; 8 April 1967; trawl; FSBC I 9137.

Remarks: *Glottidia pyramidata* is not described in this paper because it is well known. It commonly prefers sandy bottoms into which it burrows and maintains itself by a long muscular pedicle that agglutinates to the bottom of the burrow by a mucus secretion. All specimens collected during Project Hourglass are young individuals. The shells are generally creamy white to yellow, with some bright green. The largest Hourglass specimens are tongue-shaped, about 25 mm long, and with a pedicle about twice as long as the valve length. Paine (1963) has studied the life habits, ecology, and reproduction of the species in detail.

Numbers of specimens collected at each station each month are presented in Table 2. The range of depth through which they were taken is 6 to 73 meters. *Glottidia* is commonest on North American coasts but extends to Central and South America. In addition to its occurrence on the east coast, three species are known on the Pacific coast from San Pedro, California south to Peru. It is known as a fossil in Tertiary sediments of both coasts of the United States.

SUBCLASS ARTICULATA HUXLEY, 1869

ORDER TEREBRATULIDINA WAAGEN, 1883

SUBORDER TEREBRATELLIDINA MUIR-WOOD, 1955

Superfamily Terebratellacea King, 1850

Family Platidiidae Thomson, 1927

Genus *Platidia* Costa, 1852

Platidia clepsydra Cooper, new species

Plate I, Figures 1-25; Text Figures 2-6

TABLE 2. NUMBERS OF *GLOTTIDIA PYRAMIDATA* COLLECTED DURING PROJECT HOURGLASS, BY STATION AND MONTH.

Glottidia pyramidata

STA	1965					1966													1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																									5						5
B_1																															
B_2																1															1
C_1																															
C_2																															
D_1																															
D_2																								1							1
E														2																	2
I																2	2	2			3					1					10
J																															
K																															
L															2																2
M															1	1							1								3
TOT														2	3	4	2	2			3		1	1	5	1					24

Subscripts 1, 2, and sp designate regular, post, and supplementary cruises.

Material examined: HOURGLASS STATION E: 1; 9 November 1966; dredge; FSBC I 9138.–7; 2 December 1966; dredge; FSBC I 9139.–2; 3 March 1967; dredge; FSBC I 9140.–2; 12 May 1967; dredge; FSBC I 9141.–2; 2 August 1967; dredge; FSBC I 9142.–1; 6 October 1967; dredge; FSBC I 9143.–HOURGLASS STATION K: 56; 14 November 1967; dredge; FSBC I 9144.–HOURGLASS STATION M: 1; 5 September 1966; dredge; HOLOTYPE; USNM 550748a.–22; 5 September 1966; dredge; PARATYPES; USNM 550748b-g; 550749a-g; 550750a-i.–170; 5 September 1966; dredge; FSBC I 9145.–2; 13 January 1967; dredge; FSBC I 9146.–1; 9 March 1967; dredge; FSBC I 9147.–1; 8 April 1967; trawl; FSBC I 9148.–2; 8 April 1967; dredge; FSBC I 9149.–4; 6 July 1967; dredge; FSBC I 9150.–2; 8 August 1967; trawl; FSBC I 9151.–1; 8 August 1967; dredge; FSBC I 9152.–1; 12 October 1967; dredge; FSBC I 9153.

Diagnosis: Small, smooth, biconvex *Platidia* with short and narrow prongs on the septum.

Description: Small for the genus, roundly oval in outline, widest at midvalve, length slightly greater than width; unequally biconvex, the pedicle valve being the deeper, sides strongly rounded; apical angle averaging about 113°, varying from 95 to 127°. Lateral commissure straight; anterior commissure varying from rectimarginate to slightly and narrowly sulcate. Beak fairly long for the genus, beak ridges sharp; interareas fairly wide; foramen deltoid, large, margined by long narrow deltidial plates. Color white to yellowish, translucent to transparent.

Ventral valve strongly convex in lateral profile with maximum swelling at midvalve or slightly posterior thereto; anterior profile with maximum swelling at middle and with long sloping sides; umbonal region somewhat narrowly swollen, the swelling becoming stronger and widening to near midvalve; anterior slope gently convex; flanks flattening toward anterolateral extremities.

Dorsal valve in lateral profile most convex anterior to the foramen and becoming flattened at about midvalve, anterior half flat to gently concave; anterior profile forming a flattened triangle with apex very narrowly rounded and sides flattened and sloping moderately to lateral margins. Umbonal region narrowly swollen, giving the valve a pinched-in appearance posteriorly; lateral slopes of umbo flattened to gently concave and steep. Anterior half flattened; flanks at midvalve fairly steep. Pedicle opening forming a narrow half ellipse with apex directed longitudinally.

Ventral valve interior without pedicle collar; delthyrial cavity shallow, thickened and concentrically marked, indicating place of pedicle attachment; teeth cyrtomatodont type, short, thick, oblique, buttressed by low plates near lateral margin that extend anterolaterally nearly to midvalve and bear part of the body wall.

Dorsal valve interior with deeply recessed foramen with smooth unthickened margin. Socket ridge small and narrow, produced distally into a sharp pointed tooth that articulates with a fossette in the inside margin of the tooth of the ventral valve. Crura long, narrow but stout, occupying about half the length of the loop; descending branch of loop very slender and attached to distal end of septum; crural processes short but sharply pointed. Septum extending to about midvalve, pillar-like, triangular in cross-section with a steep, almost vertical anterior slope and a concave posterior slope extending to posterior edge of valve, where it is just a low ridge. Posterior edge of septum grooved, gradually thickening distally, forming a hemicylindrical gutter that is truncated bluntly, the free edges of the gutter forming two small points.

Soft parts: The pedicle occupies only a small part of the opening shared by both valves and nowhere encroaches on the dorsal valve. On the dried animal it occupies the middle of the ventral part of a tough membrane attached to the sides of the openings in both valves. The pedicle is short, 0.2 mm wide in a foramen with greatest width of 0.4 mm. The attaching end of the pedicle is fibrous, but the fibers are very short. In alcohol the pedicle appears larger and spreads out over much of the membrane covering the dorsal aperture (Text Figure 3).

The stomach and esophagus lie along the edge of the septum, and the esophagus ends at the mouth just posterior to the groove at the distal end of the septum. The digestive gland lies on each side of the septum and is very dark brown to black. An ovarian patch occurs in the mantle on each side of the dorsal valve and is usually orange brown.

The lophophore is strongly spicular as in other members of this genus and consists of a central half cylinder and two lateral half to nearly complete coils, each forming an incipient spire. Filaments lining the coils are very long and extend along the posterior side of the half cylinder.

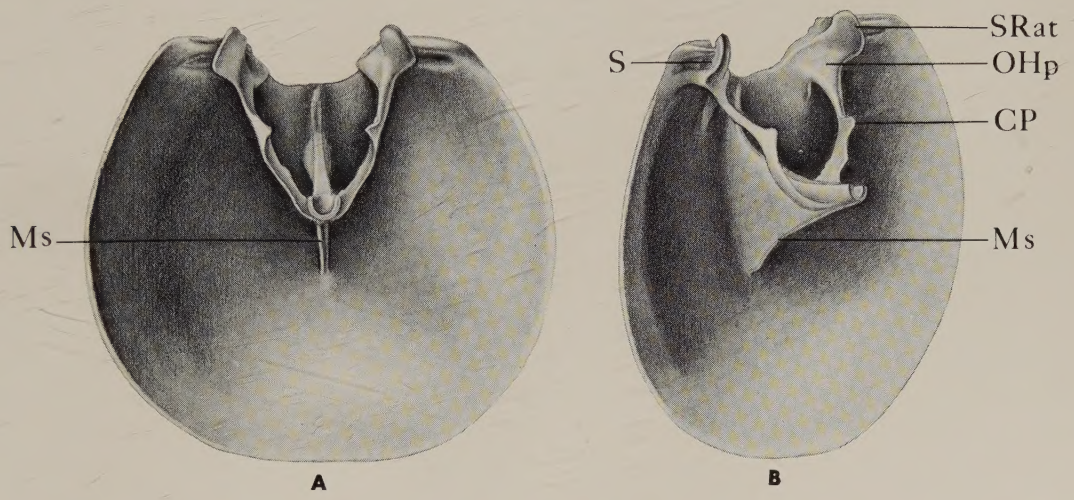

Figure 2. *Platidia clepsydra* Cooper, n. sp. Ventral (A) and partial side (B) views of dorsal valve showing loop. CP = crural process; MS = median septum; OHp = outer hinge plate; S = socket; SRat = socket ridge and dorsal articulating process. Drawn from USNM 550749c.

Musculature: The musculature is aberrant as a consequence of the posterior notching of the dorsal valve and disappearance of the cardinal process. In the ventral valve a very large flabellate muscle occupies that part of the valve immediately medio-lateral to each dental ridge. These muscles are united by numerous bundles to form a wide, flat tendonous strand that passes to the pedicle and attaches to it and to part of the adjacent membrane. These are the ventral adjustor muscles and are very large like those of *Megerlia truncata* (Linné). The dorsal adjustor muscles are long and slender, attached in the dorsal valve between the adductor muscle attachments and the crural processes about one-fifth the valve length from the posterior margin. Those taken to be the diductors are attached to the membrane closing that part of the foramen not occupied by the pedicle. These run along the underside of the membrane and pedicle as a strap-like tendon and are attached on the rim of the dorsal foramen which serves in lieu of a cardinal process. The adductor muscles are attached

in the dorsal valve, where they are double as in other articulates and are located on the valve floor just lateral of the crural process. From here they join to extend ventrally, almost touching the crural process, and attach near the middle of the ventral valve. Here the two strands are overlain by the body wall and are usually united by a white band. These are the only muscles attaching directly to both valves.

Measurements of selected specimens are presented in Table 3.

TABLE 3. MEASUREMENTS (mm) OF SELECTED SPECIMENS OF *PLATIDIA CLEPSYDRA*.

Specimen USNM 550748	Length	Dorsal Valve Length	Width	Thickness	Apical Angle
a	2.1	1.75	2.00	0.80	103°
b	2.2	1.90	1.95	0.90	107°
c	1.7	1.36	1.50	0.76	98°
d	1.9	1.70	1.90	0.82	98°
e	1.5	1.24	1.45	0.64	127°

Types: Holotype: USNM 550748a. Figured paratypes: USNM 550748b, f; 550749a-c; 550750a, c, e, f. Unfigured paratypes: USNM 550748c-e, g; 550749d-g; 550750b, d, g-i.

Type locality: About 92 nautical miles due west of Sanibel Island, Florida; Hourglass Station M; 26° 24′N, 83° 43′W; 73 m.

Comparison: This is the smallest species of *Platidia* and a very distinctive one with its white to pale yellow color and biconvex valves. It differs from *P. japonica* Dall in the marked convexity of its dorsal valve, lighter color, and elongate oval shape. *Platidia japonica* has a strongly concave dorsal valve, and its shape is transversely roundly elliptical.

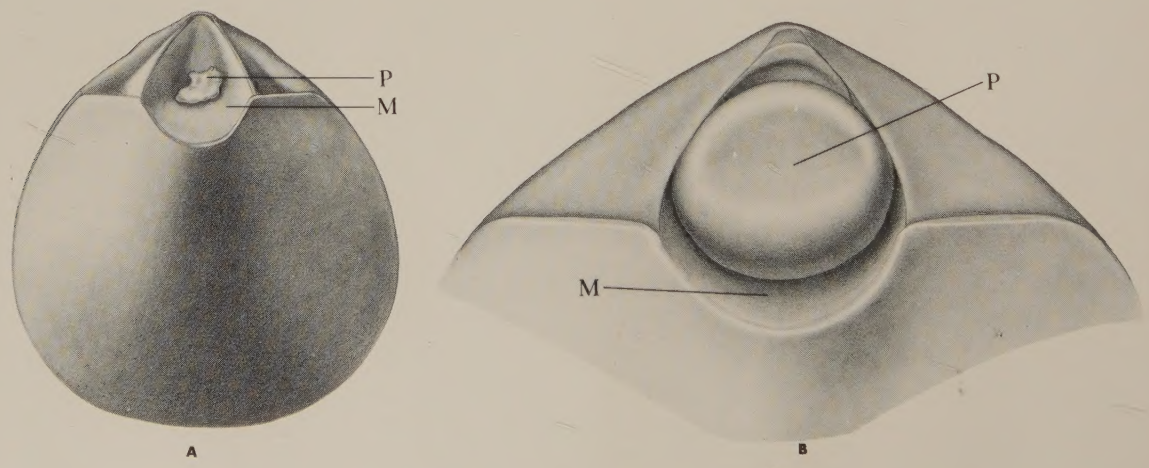

Figure 3. *Platidia clepsydra* Cooper, n. sp. A. Exterior of complete dried specimen in dorsal view showing ventral position of shrunken pedicle surrounded by membrane. P = pedicle; M = membrane. Composite drawing. B. Posterodorsal view of specimen preserved in alcohol showing fleshy pedicle spread over much of membrane. P = pedicle; M = membrane. Composite drawing.

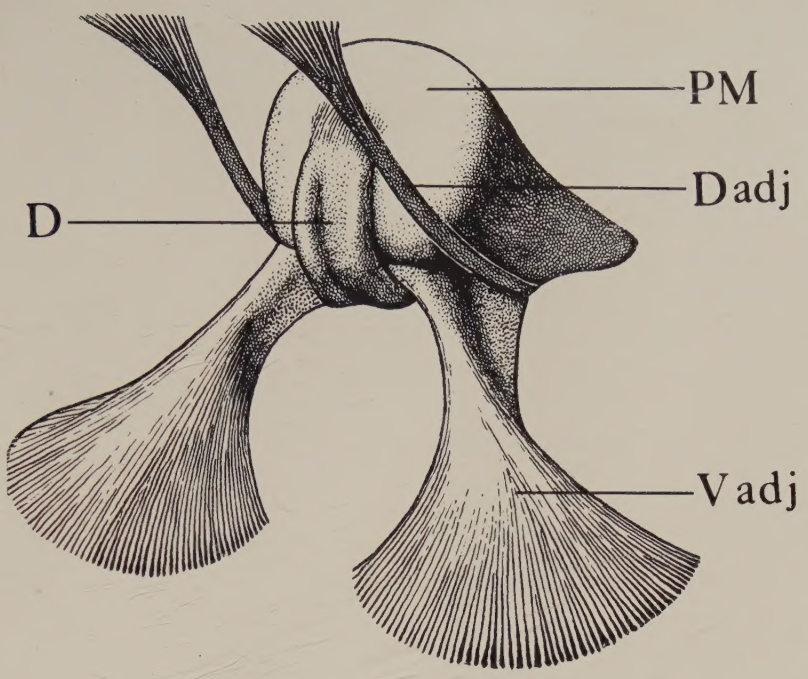

Figure 4. *Platidia clepsydra* Cooper, n. sp. Diagrammatic sketch of muscles of ventral valve, showing arrangement of some muscles in relation to pedicle and membrane. D = diductor muscle attached to underside of membrane below pedicle; Dadj = dorsal adjustor muscle attached to pedicle and membrane; PM = pedicle attached to membrane; Vadj = ventral adjustor muscle attached to pedicle and membrane. Composite drawing.

Platidia anomioides (Scacchi and Philippi) from the Mediterranean and off the west coast of Europe is darker, yellowish or brown, roundly transversely elliptical or nearly circular in outline, and has a variable dorsal valve, usually concave but often convex in the umbonal region. *Platidia davidsoni* (Deslongchamps) is large, brownish yellow, subcircular to transversely subelliptical in outline, with the ventral valve conspicuously marked by irregular excrescences. *Platidia annulata* Atkins, recently described, is similar to *P. anomioides* but differs, among other characters, in having a transverse bar joining the ascending process of the loop and forming a ring. This is the only species of the genus known with this character.

Discussion: The collection on which this discussion is based consists of 278 specimens. Numbers of specimens collected at each station each month are presented in Table 4. Most of the material is dried, and most is without fleshy parts. Fortunately, the strong spiculation of much of the flesh is responsible for holding the soft parts of the lophophore together and permitting their study in some detail. Usually, the paired valves when forcibly separated retain the muscles, some in one valve, the remainder in the other, but generally well enough preserved to make complete study possible. Parts of the shell and some details of the flesh of this little species are different from the same parts in other species of *Platidia.* Unfortunately, the national collection has few specimens of other *Platidia* in which the fleshy parts can be observed, but differences were observed in the loop and muscles.

TABLE 4. NUMBERS OF *PLATIDIA CLEPSYDRA* COLLECTED DURING PROJECT HOURGLASS, BY STATION AND MONTH.

Platidia clepsydra

STA	1965					1966												1967											TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																	1	7				2		2			2		1		15
I																															
J																															
K																														56	56
L																															
M															193				2			1	3			4	3		1		207
TOT															193		1	7	2			3	3	2		4	5		2	56	278

Subscripts 1, 2, and sp designate regular, post, and supplementary cruises.

The loop is not as stout as that described by Atkins (1959b:134) and does not have the crosspiece that produces a flattened ring as in that unique species. *Platidia anomioides* and *P. davidsoni* have strong ascending processes at the distal end of the loop and septum. *Platidia clepsydra* has the top or posteroventral face of the septum grooved. Truncation of this groove at the distal end of the septum produces a minute half circle that simulates the ascending branches of the *Platidia* loop. The ascending branches in this species apparently were not developed.

Identification and location of the muscles of this small species were attended with difficulty. The shell is thin and translucent; consequently it was not possible to see the scars of attachment. The ventral adjustor muscles, the largest pair, are conspicuous in the ventral valve. They are flabellate and fibrous in their lower part, but as they approach the pedicle they form a translucent,

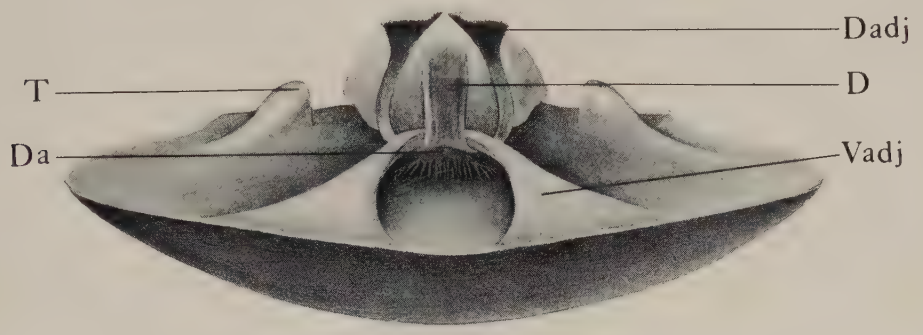

Figure 5. *Platidia clepsydra* Cooper, n. sp. Anterior of ventral valve illustrated in Text Figure 6, showing diductor and adjustor muscles. D = diductor muscle attached to underside of pedicle and membrane and in umbonal region by fibers (Da); Da = fibrous attachment of diductor muscle in apex of ventral valve; Dadj = dorsal adjustor muscles attached in this valve to pedicle and membrane, but free ends shown here attach to dorsal valve floor near crural processes; T = tooth or articulating process; Vadj = ventral adjustor muscle attached to pedicle and membrane. Drawn from USNM 550750a.

flat tendon attached on each side of the pedicle. A second pair of muscles are attached to the pedicle and the membrane to which it is fixed. This is the dorsal adjustor pair that appear in the dorsal valve inside and close to the adductor bases at about the position of the crural processes. As there are no hinge plates in this genus, these muscles have migrated to the valve floor just anterior to the posterior end of the septum. The adductor scars are thin but seem to be developed as in most articulate genera. In the dorsal valve two short adductor muscles unite to form a single strand. Their double base, an anterior and posterior muscle, is located just dorsad to the crural process, and the united strand almost touches that structure in its passage to the ventral valve. In the ventral valve the two strands are attached to the valve floor at about midvalve, one-third the valve length from the beak and just inside the base of the body wall.

Identification and location of the diductor muscles were made with considerable difficulty. No scars or trace of them could be found in the umbonal region of the ventral valve. In liquid under

high power no muscles identifiable as diductors were seen. In *Platidia anomioides* these have been diagrammed as occurring in the ventral umbo and attached to the edge of the dorsal valve (Fischer and Oehlert, 1891:99). A pair of muscles so situated should be visible at the umbo of a translucent shell and also in the large cavity formed by the dorsal and ventral openings. What is taken to be the diductor or its remnant in *P. clepsydra* is a brown strap-like tendon attached to the underside of the pedicle and extending posteriorly to the edge of the dorsal valve. Posteriorly, a mass of fibers is attached to the pedicle and membrane and the valve floor. These appear as minute strands near the apex (Text Figure 6).

The pedicle when seen in specimens in alcohol is a thin, fleshy expansion spreading over much of the surface of the united openings in the two valves. In dried specimens the pedicle shrinks to a thin disc resting on top of the membrane covering the openings of both valves. It does not penetrate to the interior of the valve and in the dried state is confined to the ventral side of the animal. The pedicle is an important part of the opening apparatus of this brachiopod as is the membrane on which it rests. The pedicle as indicated above is intimately attached to the adjustor and diductor muscles. Contraction of these three pairs draws the pedicle toward the interior, thus stretching the pedicle which is strongly attached to the substrate. This also compresses the interior. These movements tend to lift the valve on the pedicle, and contraction of the membrane causes the valves to open. Atkins (1959a:129) records a gape of 45° for *Platidia anomioides*.

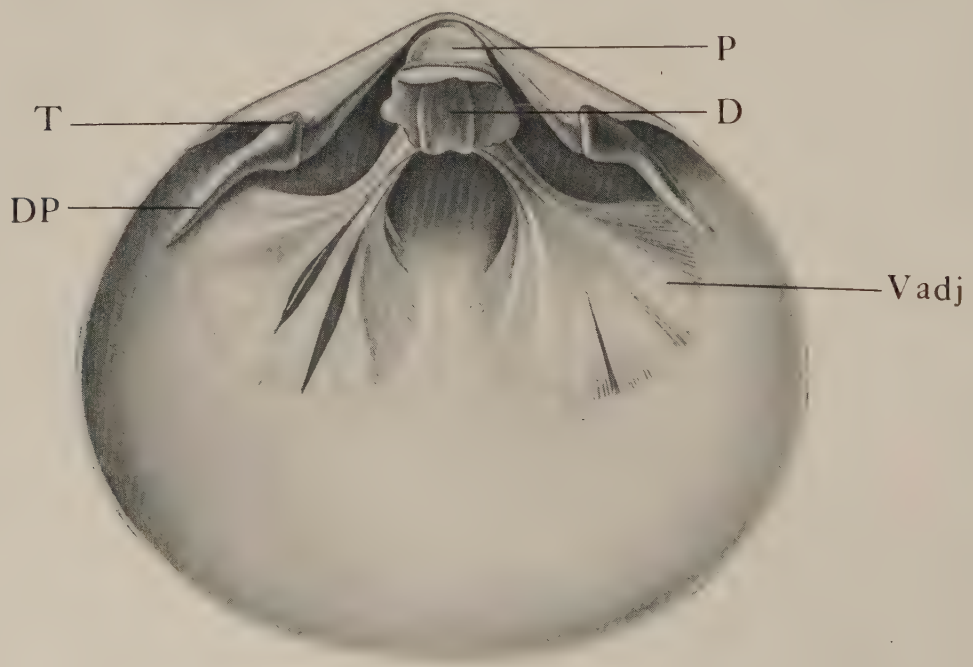

Figure 6. *Platidia clepsydra* Cooper, n. sp. Interior of ventral valve showing adjustor and diductor muscles in place and other details of valve. D = diductor muscle in position on underside of membrane; DP = dental plates buttressing teeth; P = pedicle; T = tooth; Vadj = ventral adjustor muscles attached to pedicle and membrane. Drawn from USNM 550750a.

For the valves of *Platidia clepsydra* to open it is necessary for the animal to be lifted clear of the substrate to which it is tightly and closely attached. This is evidently the role of the unusually well developed ventral adjustor muscles. A muscular system similar to that of *Platidia* also occurs in *Megerlia* and *Argyrotheca.* In both of these genera the ventral adjustors are so large that they might be mistaken for the diductors in the more usual arrangement of the muscles of articulate brachiopods.

In addition to *Platidia clepsydra*, two larger species, *P. anomioides* (Scacchi and Philippi) and *P. davidsoni* (Deslongchamps) are known from the Gulf of Mexico. The latter has a pustulose ventral valve, but the former has concentric lines of growth only. Fossil *Platidia* occur in the Eocene of the Atlantic and Gulf coasts of the United States, in the Caribbean, and in the Upper Pliocene of the west coast. Living examples occur off the California coast.

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Plate I

Platidia clepsydra Cooper, n. sp. Figures 1-25. All from Station M.

Figures 1-5. Anterior, posterior, side, ventral and dorsal views, X10, of holotype, showing amphithyridid foramen; USNM 550748a.

Figure 6. Ventral view of small specimen attached to fragment of coralline alga, X10; paratype USNM 550748f.

Figures 7-11. Posterior, anterior, side, ventral and dorsal views, X10, of another complete specimen; paratype USNM 550748b.

Figure 12. Posterior part of a ventral valve, X20, showing interarea, teeth and their curving lateral supports; paratype USNM 550749c.

Figure 13. Ventral view, X20, of dorsal valve interior showing loop; paratype USNM 550749b.

Figures 14-15. Ventral and laterally tilted views, X20, of another dorsal valve interior, showing loop with its descending branches; paratype USNM 550750c.

Figure 16. Interior of a ventral valve, X20, showing interarea, deltidial plates and teeth; paratype USNM 550750e.

Figure 17. Interior of both valves, X20, showing lophophore, ends of adductor muscles and ventral adjustor muscles in ventral valve (lower one), and articulating processes of dorsal valve; paratype USNM 550750f.

Figure 18. Interior of dorsal valve showing spirolophous lophophore, attachment ends of diductors, and frayed ends of diductors torn from integument covering foramen; paratype USNM 550750e (counterpart to ventral valve shown by Figure 16).

Figures 19-22. Ventral, partial side, posterior and anterior views, X20, of a dorsal valve interior, showing loop with descending branches and tiny points at distal end of septum (Figure 22); paratype USNM 550749c (counterpart to ventral valve shown by Figure 12).

Figures 23-24. Interior of ventral and dorsal valves showing details of musculature and lophophore, X20; ventral valve showing pedicle and integument attaching it to foramenal edges, dorsal pedicle muscles and dorsal ends of diductor muscles; dorsal valve showing lophophore and end of intestine; paratype USNM 550749a.

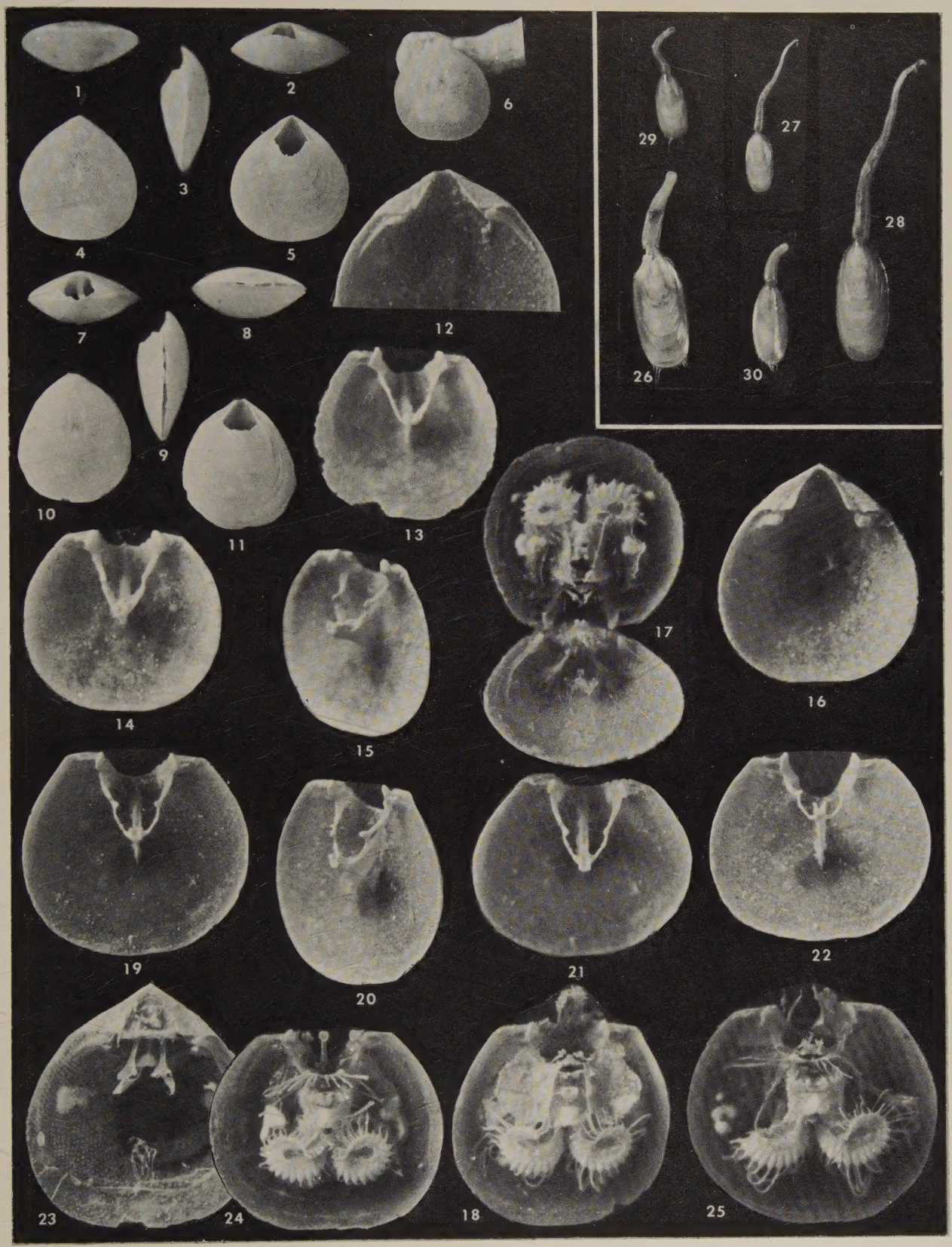
Figure 25. Interior of dorsal valve, X20, showing lophophore and ends of dorsal adjustors; paratype USNM 550750a.

Glottidia pyramidata (Stimpson) Figures 26-30.

Figure 26. Ventral view, X2, of somewhat damaged specimen, showing some anterior setae; hypotype USNM 550751a; Station I.

Figures 27-28. Ventral views of a large specimen with long pedicle, X1, X2; hypotype USNM 550752a; Station I.

Figures 29-30. Ventral view of two small specimens with short pedicles, X2; hypotypes USNM 550753a, b; Station A.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